DISSERTATION ON

A STUDY OF MANAGEMENT OF THE SEVERE OPEN TIBIAL FRACTURES WITH EARLY BONY FIXATION AND SOFT TISSUE COVERAGE

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CERTIFICATE

This is to certify that this dissertation entitled ***"A study of management of the severe open tibial fractures with early bony fixation and soft tissue coverage"*** is a bonafide record work done by Dr.B.ThanigaiArasu is submitted as partial fulfillment for the requirements of M.S. Degree Examinations Branch II, Orthopaedic Surgery, MARCH 2007.

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ANNEXURE

INTRODUCTION

In this era of machines and auto mobiles severe open fractures resulting from high energy injuries are common and the treatment and management is complex. Tibia fractures – because of its unique antinomy and vulnerable soft tissue envelope and contamination of the wound are very difficult to treat. Traditionally open tibial fractures have been managed by repeated debridement, external fixation, and delayed soft tissue coverage persisting with perennial complication. Today we need an aggressive radical approach to the management of these devastating injuries.

SEVERE OPEN TIBIAL FRACTURE:

Result from high energy trauma

1. Road Traffic Accidents
2. Accidental falls
3. Machinery injuries
4. War injuries

EPIDEMIOLOGY

The average number of grade II & III open injuries of tibia seen by an orthopedic surgeon in UK is less than 2 per year while it is at least 20 times more in developing countries. In India alone, more than 80000 people are killed on the roads and about 1.2 Million suffer serious limb injuries. Road traffic accidents and industrial accidents due to poor safety norms contribute to high incidence of open injuries.

CLASSIFICATION OF OPEN FRACTURES

Type	Wound	Level of Contamination	Soft Tissue injury	Bone injury
I	<1 cm long	Clean	Minimal	Simple, mini mal commi-nution
II	>1 cm long	Moderate	Moderate, Some muscle damage	Moderate Comminution
III A	Usually>10 Cm long	High	Severe with crushing	Usually com-nuted: soft Tissue cover-age of bone possible
B	Usually>10 Cm long	High	Very severe loss of cove-rage; usually requires soft t tissue reconstructive surgery	Bone cover-age poor; variable, may be mo-derate to severe comminution
C	Usually >10 Cm long	High	Very severe loss of coverage plus vascular injury re-quiring re-pair; may require soft tissue re-constructive surgery	Bone cover-age poor; variable, may be mo-derate to severe comminution

Treatment goals

1. Address systemic issue to ensure survival of the patients and appropriate treatment of associated injures.
2. Identify and treat vascular injuries that threaten limb survival.
3. identify and treat peripheral nerve injuries while preventing further nerve compromise.
4. Diagnose and treat compartment syndrome.
5. Irrigate, debride and prevent infection in open fractures.
6. Achieve viable full-thickness of soft-tissue coverage early by 10 days if possible.
7. restore and maintain the anatomy of the tibia within acceptable limits.
8. Achieve fracture union by 24 weeks or earlier.
9. Restore limb function with good ankle, subtalar joint and knee motion with muscle strength compared to normal.
10. Avoid complications particularly infection non union and mal union.

Treatment modalities

A. Irrigation and Debridement.

B. Stabilization of the Bone by Immobilization in Plaster, Skeletal Traction and Suspension, External Skeletal Fixation and Internal Fixation.

C. Wound Management

   a. Primary Closure

   b. Delayed Primary Closure

   c. Relaxing Incisions

   d. Split Thickness Skin Grafts

   e. Flap Coverage

D. Biologic Dressings

E. Elevation

F. Antibiotics

Operative fixation

a. External fixation

Pins in plaster

Full pin fixation (hoff mann)

Half pin fixation

Circular fixation with tensioned wires, half pins, hybrid fixation.

b. Intramedullary nails

- Flexible nails
- Non locking nails
- Locking nails used : reamed or non reamed.
- Locking : None, dynamic or static.

c. Plate and screw fixation

- Screws alone.
- Rigid plate fixation with compression
- Biological fixation.

COMPLICATIONS

1. Infection

It must be recognized early and irrigation and debridement must be done at expeditiously as possible.

Remove all acutely infected intramedullary nails and convert to external fixation. Antibiotic impregnated beads are useful.

2. Loss of skin and soft tissue.

For skin and soft tissue defects in the proximal third of the tibia, swing the medical head of gastrocnemius muscle on its vascular pedicle for coverage, apply split thickness skin grafts to the muscle pedicle as necessary.

3. Neuro Vascular injury

The nerve most often injuried in tibial fracture is the common peroneal nerve. Examine the limb carefully at the time of initial injury, record any evidence of sensory loss or motor weakness.

A laceration directly over the main bundle of the nerve requires exploration; otherwise treatment is limited to observation, prevention of

the equinus contractures and musle rehabilitation. Anterior tibial artery, posterior tibial artery and peroneal artery are the three arteries supply the lower extremity distal to the knee. Vascular repair of a single artery laceration is rarely necessary, if the fate of the two arteries is unknown, laceration of posterior tibial artery are often repaired.

Fracture of the shaft of fibula.

In the absence of dislocation of the proximal or distal tibiofifular joints, fracture of the fibula accompanying a tibial fracture requires no special treatment.

AMPUTATION

It is destructive and wasteful to invest 2 yrs 3 yrs in an attempt to salvage a limb that is finally amputated. Because it is painful and dysfunctional.

The surgeon and patient must decide whether early amputation is indicate for a mangled limb or whether the major repeated surgeries required to salvage the limb would leave the patient with an extremely more useful than a below knee prosthetics.

Mangled extremity serenity score

Type	Characteristic	Injuries	Point
A. Skeletal / soft tissue group			
1.	Low energy	Stab wound, simple closed fracture	1
2.	Medium energy	Open or multi level fractures.	2
3.	High energy	High velocity gunshot wounds.	3
4.	Massive crush	Logging, railroad, oil rig accident.	4

Type	Characteristic	Injuries	Point
B. Shock group			
1.	Normotensive hemodynamic	BP stable	0
2.	Transiently hypotensive	BP unstable but responsive to intravenous fluids.	1
3.	Prolonged hypotension	Systolic BP less than 90mm Hg in field and responsive to intravenous fluids only in operating room.	2

Type	Characteristic	Injuries	Point
C. Ischemia group			
1.	None	apulsatile limb without signs of ischemia.	0
2.	Mild	Diminished pulse without signs of ischemia.	1
3.	Moderate	No pulse, sluggish capillary refill, paresthesia.	2
4.	Advance	Pulseless, cold, paralyzed and numb without capillary refill.	3

Age group

1.	< 30 yrs	0
2.	>30<50 yrs	1
3.	>50 yrs	2

Note :

Point X 2 if ischemic time exceeds 6 hrs.

Indications of primary amputation

Absolute indication

Anatomically complete disruption of the posterior tibial nerve in adults.

Crush injuries with warm ischemia time > 6 hrs.

Relative indications

- Serious associated polytrauma.
- Severe ipsilateral foot trauma.
- Anticipated protracted soft tissue and osseous reconstructions.

1. AIM:

The study was conducted to assess the functional out come of the management of severe open tibial fractures treated by early soft tissue coverage and bony fixation.

2. METHODS AND MATERIALS:

21 Patients (15 Males and 6 Females) between the ages of 18years to 50 years with severe open tibial fractures treated by surgical intervention single stage primary internal fixation with interlocking nail or narrow dynamic compression plates followed by flap cover, relaxing incision, split skin craft within 24 hours during the period January 2005 to June 2006.

INCLUSION CRITERIA

1. Age 18 years to 50 years.

2. Isolated severe open fractures of both bones of legs – Gustilo and Anderson grade 2, grade 3a, grade 3b.

EXCLUSION CRITERIA:

1. Age less than 18 years and more than 50 years.

2. Multiple injuries – Head injury, Abdominal injury, chest injury and other limb injuries.

3. Gustilo Anderson grade 1, grade 3c.

Systemic diseases – Diabetes mellitus.

Cirrhosis liver,

Severe Anemia.

4. ASSESSMENT OF INJURY

CLINICAL EVALUATION:

1 . Resuscitation with intravenous fluids.

2. Immobilization of the injured limb in Thomas splint.

3. To rule out other injuries like head thorax, abdomen.

4. To photograph the wound.

5. To rule out distal neurovascular injury.

6. To assess soft issue injury.

7. To assess level of contamination.

8. To classify the wound by Gustilo and Anderson classification.

RADIOGRAPHIC EVALUATION:

1. X – Ray of Knee with leg with ankle – AP view, Lateral view.

   Assess the site of fracture, communition of fracture.

PRE – OPERATIVE STEPS :

1. In the trauma ward – wound swab is taken and sent for pus culture and sensitivity.
2. Wound wash given with 2 liters of normal saline and beta dine soaked dressing applied.
3. Antibiotics – Injection: Cefotaxime 1 gm i.v given.

   Injection: Gentamycin 80 mg i.v given.

   Injection: Metronidazole 500 mg i.v given.

OPERATIVE STEPS :

1. Anesthesia – Regional – Spinal
2. Position – Supine.
3. Wound wash – In 2 stages.
    i. Groin to foot is washed with 10 L to 15 L of theatre saline.
    ii. Wound is washed with 15 L of theatre saline and detergents. (Savlon soap, Hamam soap).
4. Surgical site and donor area for flap cover and split skin graft are painted and draped.
5. Tournique is not used.

PRINCIPLE OF SURGERY:

1. Radical wound debridement.

Immediate internal fixation of bone and soft tissue coverage.

RADICAL DEBRIDEMENT:

1. All the visible contaminants present in the wound are removed.
2. Devitalized skin, Subcutaneous tissue, muscles, and totally detached bone fragments are debrided.
3. The final wound classification is defined.

    From Gustilo Anderson

    Grade 2 to Grade 3a.

    Grade 3a to Grade 3b.

4. Donor site for flap cover, SSG are marked

BONY STABILIZATION

1. Internal fixation by inter locking nails and narrow dynamic compression plate.
2. While doing interlocking nailing the medullary canal is minimally reamed.
3. Fracture is reduced and ante grade nailing done with inter locking screws.
4. Fracture fibula – no intervention done.
5. Narrow dynamic compression plates used 10-14 vots with cortical screws.

SOFT TISSUE COVERAGE:

1. After bony fixation the wound is closed by
    i. Relaxing incision and split skin graft.
    ii. Muscle pedicle graft medial gastronomiues, cross leg flap.
    iii. Fasciocutaneous flap – cross leg flap.
2. The wound is closed in layers over suction drain after securing complete homeostasis.
3. Sterile dressing done.
4. POP – AK slab given in 15 degree knee flexion and ankle in neutral position.

BLOOD TRANSFUSION:

1 unit of compatible blood was transfused during the surgery.

ANTIBIOTICS AND ANALGESICS:

1. Injection Cefotaxime 1 g i.v bd ATD
2. Injection Amikacin 500 mg i.v bd.

Antibiotics are change according to the pus culture and sensitivity result.

3. TABLET CALCIUM, VITAMIN C ARE ADDED WHEN THE PATIENTS STARTED TAKING ORALLY,

POST OPERATIVE PROTOCOL:

1. Limb elevation to prevent flap edema and distal edema for 5 days.
2. First look of flap cover on 2nd POD.
3. Drain tube removed on the 2nd POD and sent for pus culture sensitivity.
4. First look of SSG on 4th POD.
5. Sterile dressing done on alternate days.
6. Knee and ankle mobilization first week.
7. Suture removal 12th POD
8. Non weight bearing for 4 weeks.
9. Partial weight bearing for 4 to 6 weeks till the radiological sound union later full weight bearing.

REVIEW OF LITERATURE

REVIEW 1

Department of Orthopaedics and Trauma, St James's University Hospital, Keeds, Uk.

In a retrospective review of the case notes of 84 consecutive patients who had suffered a severe (Gustilo IIIb or IIIc) open fracture of the tibia after blunt trauma between 1990 and 1998. All being treated by a radical protocol which included early soft – tissue cover with a muscle flap by a combined orthopaedic and plastic surgery service.

The ideal management is a radical debridement of the wound outside the zone of injury, skeletal stabilization and early soft – tissue cover with a vascularised muscle flap. All patients were followed clinically and radiological to union or for one year. After exclusion of four patients (one unrelated death and three patients lost to follow –up).

In their study they reviewed 80 patients with 84 fractures. There were 67 men and 13 women with a mean age of 37 years (3 to 89). Five injuries were grade III c and 79 grade III b; 12 were site 41, 43 were site 42 and 29 were site 43. Debridement and stabilization of the fracture

were invariably performed immediately. In 33 cases the soft – tissue reconstruction was also completed in a single stage, while in a further 30 it was achieved within 72 hours. All grade – III c injuries underwent immediate vascular reconstruction, with an immediate cover by a flap in two stages.

There were four amputations, one early, one mid – term and two late, giving a final rate of limb salvage of 95%. Overall, nine pedicle and 75 free muscle flaps were used; the rate of flap failure was 3.5%. Three patients had significant segmental defects and required bone – transport procedures to achieve bony union.

Of the rest, 51 fractures (66%) progressed to primary bony union while 26 (34%) required a bone – stimulating procedure to achieve this outcome. Overall, there was a rate of superficial infection of the skin graft of 6%, of deep infection at the site of the fracture of 9.5%,and o serious pin – track infection of 37% in the external fixate group.

At final review all patients were walking freely on united fractures with no evidence of infection.

REVIEW 2

Parrett BM, Matros E, Pribaz JJ, Orgill DP.

Division of Plastic and Reconstructive Surgery, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts 02478, USA.

In their study the number of open lower extremity fractures increased, whereas the distribution of Gustilo grade I to III fractures remained unchanged. Free – tissue transfer was performed less frequently and constituted 20 percent of reconstructions in period 1 (1992 to 1995), 11 percent in period 2(1996 to 1999), and 5 percent in period 3 (2000 to 2003).

For the most severe fractures, Gustilo grade III, free – flap reconstruction has decreased significantly, constituting 42 percent, 26 percent and 11 percent of procedures in periods 1,2, and 3, respectively. Local flaps for grade III fractures have remained relatively constant throughout the study.

In contrast, local wound care for grade III fractures, including skin grafts, delayed primary closures, and secondary intention closures has

significantly increased from 22 percent to 49 percent of reconstructions from periods 1 through 3. In 1997, the authors began to use the vacuum – assisted closure device and now use it in nearly half of all open fractures. Despite this trend, there has been no change in infection, amputation, or malunion/nonunion rates and a decrease in reparation rate with at least 1 – year follow – up.

Their results demonstrate a change in practice, with a trend down the reconstructive ladder, currently using fewer free flaps and more delayed closures and skin grafts with frequent use of the vacuum – assisted closure sponge. Possible reasons for this change are a better understanding of lower leg vascular anatomy and better use of improved wound care technology.

REVIEW 3

Department of Musculoskeletal Surgery, Imperial College School of Medicine, Charging Cross Hospital Campus, London w6 8RF, UK.

They reviewed 73 consecutive grade IIIB open tibial shaft fractures with a mean follow – up of 14 months (8 to 48). There were 26 fracture in the primary and 47 in the tertiary group. The initial skeletal fixation required revision in 22 (47%) of the tertiary patients. Although there was no statistically – significant relationship between flap timing and flap failure, all the failures (6 of 63; 9.5%) occurred in the tertiary group.

The overall mean time to union of 28 weeks was not influence by the type of skeletal fixation. Deep infection occurred in 8.5% of patients, but there were no persistently infected fractures. The infection rate was not increased in those patients derided more than six hours after injury. The limb salvage rate was 93%. The mean limb functional score was 74% of that of the normal limb. At review, 67% of patients had returned to employment, with a further 10% considering a return after rehabilitation.

REVIEW 4

At Ganga Hospital, Coimbatore, India. A specialized unit for limb reconstruction evolved with a team of skilled orthopaedic surgeons and plastic surgeons skilled in microsurgical reconstructions.

IN THEIR THEY REVIEWED 33 PATIENTS (29 ADULTS AND FOUR CHILDREN) WITH 34 GUSTILO GRADE III B OR GRADE III C FRACTURES FROM A GROUP OF 40 PATIENTS WHOSE TREATMENT WITH THE FIX AND FLAP PROTOCOL WAS COMPLETED BETWEEN 1996 AND 2000. THREE PATIENTS COULD NOT BE REVIEWED BECAUSE THEY HAD SUFFERED SEVERE CONCOMITANT HEAD INJURIES, AND FOUR PATIENTS WERE LOST TO FOLLOW-UP. THERE WERE 25 MEN, TWO BOYS, FOUR WOMEN AND TWO GIRLS IN THE STUDY GROUP. THE MEAN AGE FOR THE ADULT GROUP WAS 48 YEARS (19 TO 79).

The fix and flap protocol consists of a radical debridement of unhealthy soft tissues to the edge of the zone of injury, skeletal stabilization (preferably internal) with an implant appropriate for the bony anatomy and immediate soft tissue cove with a muscle flap.

The choice between a pedicle or a free muscle flap depended on the anatomy of the soft – tissue injury. If immediate soft-tissue reconstruction was not practical their aim was to obtain soft-tissue cover with in 72 hours of the injury. After the surgery to the leg, early mobilization, including 'toe touch' weight-bearing and joint motion was encouraged. Weight-bearing was increased as soon as possible, depending on the stability of the fracture and the signs of its healing.

They revised a new scoring system to define the classification of compound injuries.

Ganga hospital open injury score: (Ref)

Ganga Hospital Open Injury score was developed in 1994 to overcome the disadvantages of Gustilo's classification. After three clinical trials and suitable modifications, the score was derived to its present form and has been validated in a prospective study. The score allotted points from 1 – 5 according to the severity of the injury to each of the three components of the limb; the covering tissues (skin and fascia), functional tissues (muscles, tendons and nerve units) and skeleton (bones and joints).

The presence of systemic factors which influence the treatment and outcome, were allotted a score of two each and the final score arrived by adding the individual scores.

The weight age for the injuries was given in such a way that score ‘one’ and ‘two’ for any tissue meant that no special secondary procedures would be required for the repair and healing of that particular structure and the ultimate outcome for the limb will not be poorly influenced by the injury of that structure.

A score of ‘three’ meant that some special procedure will be required for healing of that tissue but a good functional outcome can be achieved with appropriate management.

A score of ‘four’ or ‘five’ meant that the injury was of such severity, that it would involve multiple procedures for healing, would be a cause for prolonged hospital stay, would involve increased treatment costs, would negatively influence the healing of other components of the limb, and could ultimately lead to a poor functional outcome.

Ganga Hospital Open injury Severity Score (GHS)

Covering Structures: skin and fascia Score

Wounds with out skin loss:

1.Not over the fracture

2.Exposing the fracture

Wounds with skin loss

3.Not over the fracture

4.Over the fracture

Circumferential would with skin loss Skeletal structures: bone and joints

Transverse / oblique fracture / Butterfly fragment <50%

Circumference

1.Large butterfly fragment > 50%

Circumference

2.Comminution / segmental fractures without bone loss

3.Bone loss < 4 cm 4.Bone loss > 4 cm

5. Functional tissues: musculotendinous (MT) & nerve units

Partial injury to MT unit 1

Complete but repairable injury to MT units 2

Irreparable injury to MT units /partial loss of a compartment /

Complete injury to posterior tibial nerve 3

Loss of one compartment of MT units 4

Loss of two or more compartments / Subtotal amputation

Co – morbid conditions: Add 2 points for each condition present

1. Injury –debridement interval >12 Hrs.
2. Sewage or organic contamination / farmyard injuries
3. Age > 65 yrs.
4. Drug dependent diabetes mellitus / cardio respiratory diseases leading to increased anesthetic risk.

5. Poly trauma involving chest or abdomen with ISS > 25/fat embolism.

6. Hypotension with systolic blood pressure < 90 mm Hg at presentation.

7. Another major injury to the same limb/compartment syndrome.

Review – 5

Assure, The University of Leeds in this study, the mean SF – 36 physical and mental scores of 49 and 62 respectively are low compared with the normal population, reflecting the seventy of these injuries.

Saving life and limb takes the highest priority, followed by rehabilitation. The psychological impact of trauma is often neglected. Pain is a major precipitating factor for psychological disturbance.

The mean pain score for the nine patients with a mean mental score <60 was 43.3 whereas that for the other 20 patients was 57.8. Patients scored better if they had an isolated tibial fracture and achieved primary bone union but this observation on both the SF – 36 and the EQ-5D questionnaires did not reach statistical significance, probably due to a type II error on small numbers.

On the other hand, of the 22 fractures with early flap cover, 12 (54.5%) had other significant lower limb injuries whereas in the group whose flap cover was completed late, only two of eight (25%) had other lower limb injuries. It is one impression that the poorer functional outcome in this group is due to the compounding effect of the other

injuries, especially that to the CNS, despite better fracture union rates and no incidence of osteomyelitis. The mean range of movement for the knees and ankles in their study again correlates with similar studies where open tibial fractures were treated by internal fixation.

REVIEW 6

Bosse et al suggest that reconstruction gives outcomes which are equivalent to those of amputation at two-year follow-up; Hertel, Strebel and Ganz, report a significantly higher number of amputees required retraining and long-term invalidity pensions compared with patients who had them limbs salvaged. There are also greater psychological implications for amputation.

Hoogendoorn and Van der Werken found a mean functional impairment of the lower extremity in patients with limb salvage of 17.6% contpant with 73.5% for amputees although They did not find significant difference between the two groups, using the Nottingham Health Profile (NHP) and the SF-36 scores.

Both of these groups had poorer scores than a healthy reference group. Dagon et al found that the scores for their injured group were lower than those for patients with serious medical illnesses irrespective of the treatment (salvage or amputation).

They also noted significantly lower SF-36 physical scores for primary and secondary amputees (28 for amputees versus 38 for salvage).

In common with Dagon et al's study, all our patients expressed their satisfaction at retaining their limbs.

The SF-36 scores in our study compare well with the above-mentioned studies. In this study and others shows that limb salvage remains a reasonable option.

REVIEW 7

SF – 36 and Euroqol

In this study the outcome and functional status of 33 patients with 34 severe open tibial fractures (Gustilo grade III b and III c). The treatment regime consisted of radical debridement, immediate bony stabilization and early soft – tissue cover andardized assessments of health – related quality of life and measurement of the following parameters: gait, the use of walking aids, limb – length discrepancy, knee and ankle joint function, muscle wasting and the cosmetic appearance of the limb.

Personal comments and over all patient satisfaction were also recorded. The mean follow – up was 46 months 915 to 80).

There were 30 Gustilo grade IIIb fractures and four grade III c fractures. Of the 33 patients, 29 had primary internal fixation and four, external 11(34%) later required further surgery to achieve union and two needed bone transport procedures to reconstruct large segmental defects.

The mean time to union was 41 weeks (12 to 104). Two patients (6.1%) developed deep infection; both resolved with treatment. The mean

SF-36 physical and mental scores were 49 and 62 respectively. The mean state of health score for the Euroqol was 68. Patients with isolated tibial fractures had a better outcome than those with other associated injuries on both scoring systems. Knee stiffness was noted in seven patients (21%) and ankle stiffness in 19 (56%); 12 patients (41%) returned to work.

OBSERVATION AND RESULTS

The study was conducted during the period 1.1.05 to 1.6.06 in patients With male preponderance the longest follow - up 14 months and shortest Follow-up 7 months the average time lag between injury and surgery is 10.33 hours.

No tourniquet is used because to assess the zone of injury. 10 to 15 l of theater saline was used for irrigations. The Bony stabilization was done with inter locking nails with minimal reaming in 19 patients and compression plates in two patients. Fractures with Bone loss were not included.

1 unit of compatible Blood was transfused in all the surgeries. Soft tissue coverage was provided by flap coverage relaxing incision SSG. For 2 patients who hade deep infection and necrosis debridement and SSA done. One patients was lost in the follow-up. 8 cases had flap cover by medial gastrocnemius, one had cross leg flap, one had reverse sural flap, five had relaxing incision and SSG and 6 cases had debridment and primary closer. The Radiological union was sound the average of 31.2 weeks.

Complications:

1. Anterior Knee pain-6 cases
2. Superficial infections in 5 cases
3. Deep infections in 3 cases

Result:

The post operative complications, time taken for bony union and the range of movements of ankle and knee were taken for the assessment of functional outcome and results.

Good – 15 – (71.4%)

Fair – 3 – (14.3%)

Poor – 3 – (14.3%)

DISCUSSION

In this study the younger adult who reach the hospital with less Time lag between injury and surgery and less wound contamination showed good results. Most of the adults who were the soul bread winners of the family took up the regular work the period of 9 months.

By the aggressive approach of radical debridement early internal fixation and soft tissue coverage with appropriate antibiotics most of the complex and compound fractures were treated showing good results. In this study no secondary procedures like bone grafting, Repeat debridement, revision flap and amputations were done.

To combat these devastating injuries the specialist Reconstruction protocol is regarding. All the patients were pleased to retain the limbs.

Godina brought a new dimension to the treatment of these injuries by advocating the use of free tissue transfer very early, within five days of the injury. Effective internal fixation facilitates soft-tissue cover and secondary bone grafting, together with improved patient compliance.

In this study I combined these two approaches of Godina's concept to the extreme, advocating where possible immediate soft-tissue and bony reconstruction.

The salient features of this study, which led to a high rate of success, can be summarized as follows:

Open injuries were jointly assessed and managed by a team of orthopaedic, plastic and anesthetic consultant on arrival to the hospital. The same team was responsible through all stages of further management of resuscitation, decision of salvage, debridement and definitive treatment. The continuity of care provided by the involvement of the same team from resuscitation, through reconstruction and rehabilitation produced enormous benefits in terms of patient confidence and surgeon commitment to achieve the best results.

The close involvement of a consultant anesthesiologist primarily interested in trauma through all stages of patient care was a central core of the philosophy. The consultant was involved with the patient from the time of arrival in providing resuscitation, primary pain relief, making the

patient fit for all major reconstructive procedures, and also good post – operative care during the entire hospital stay.

The initial assessment and resuscitation was done in a large anteroom of the trauma theatre. This had many advantages. The anesthesiologist, orthopedic and plastic surgeon were able to immediately assess the injury and the patient as a whole. This global team assessment allowed important decisions of management to be taken without any wastage of time. The lag time required for the patient to be moved to the operation theatre whenever a damage control surgery was required was also minimized.

Providing primary evaluation and resuscitation in the anteroom of the theatre also allowed the possibility of providing pain relief to patients by what we have termed as ‘On arrival regional blocks’. After the initial functional assessment of the limb was over and documented, the anesthesiologists went ahead to provide pain relief by appropriate regional block. This made radiological and further handling of the patient pain free.

The index surgical procedure and debridement is always performed jointly by a team of orthopaedic and plastic surgeons at consultant level who are well experience in debridement and reconstruction options. Involvement of thorthopaedic and plastic surgeon during the index procedure itself. After debridement, the surgeons carefully examined the wound to document what is lost. Whenever debridement was adequate, an aggressive attitude to reconstruction was adopted. Rather than 'why?' the philosophy was 'why not now?'. This allowed the development of newer principles like primary closure of open injuries, immediate wound cover, and primary bone grafting, early bone transport under flaps and immediate global reconstruction.

The protocol of primary closure in open injuries is controversial and requires discussion. The widely accepted standard of care in the management of open wounds is to leave the wound open after debridement and to delay the closure to a later date. This concept has been carried over from the experiences and results of wounds from war setting and needs to be reevaluated in the present situation of advanced clinical care.

The need for a thorough debridement by an experienced team cannot be overemphasized. Wounds must be extended so that better visualization is achieved. Skin must be delicately handled and there must be reluctance to excise the skin without discretion.

Most often, the only debridement required at skin level is a marginal excision of the skin, not extending more than a few mms. Excision to document bleeding margins is sufficient.

Deep abrasions, degloving and distally based flaps do increase the chance of skin necrosis but excising such skin in the presence of bleeding margins is to be condemned.

While we follow the principle of ‘when in doubt, excise’ in dealing with muscles, fascia and bone; we follow the principle of ‘when in doubt, it is better to conserve’ in dealing with the skin.

Skin does not get infected and rarely necroses when it has bleeding margins and tension has been avoided during suturing.

In the rare event that it is found to be partially non-viable and has to be partially excised during the retook and debridement procedures, nothing is lost as it has provided adequate wound cover till the time it was excised.

If there is a skin necrosis, which is most often only marginal, excision and appropriate cover can be done. It is important that the debridement of the skin be done without tourniquet and debridement of deeper tissues with tourniquet control.

Gentle handling of the skin avoiding forceful retraction and elevating flaps of skin for better exposure must be condemned.

Ability to suture the skin ends without any tension is the most important prerequisite. The size and orientation of the wound may not clear reflect the presence of skin loss during the initial assessment.

A fractured limb always shortens and this tends to widen the wound giving the appearance of skin loss.

Once the skeleton is brought to length and stabilized, the wounds appear more linear and approximation of the skin margins are often possible without tension. The decision to retain skin flaps needs experience and must be taken after carefully considering the circumstances, the most important being presence of bleeding margins.

Whatever is the size of the skin flap, if the margins are bleeding and if it could be sutured without tension? Inconsiderate excision of all skin flaps in open injuries is something to be decried very strongly as it would increase the need for flaps unnecessarily.

To be conservative in skin and very aggressive in deeper structures has been a policy, which gives good results in our experience.

When wounds are closed, deep suction drains must be used and more than one drain is required if there are pockets of dead space that may collect a hematoma.

In patients in whom large muscles have been debrided we sometimes also prefer to keep dependent corrugated drains so that collection of hematoma in dead spaces is totally avoided.

‘Fix and flap’ protocol

An aggressive ‘fix and flap’ protocol, consisting of radical debridement, internal fixation and immediate or very early soft-tissue cover with muscle flaps, has been reported to give faster union times ad lower infection rates.

By the aggressive approach of radical debridement early internal fixation and soft tissue coverage with appropriate antibiotics most of the complex and compound fractures were treated showing good results.

In this study no secondary procedures like bone grafting, Repeat debridement, revision flap and amputations were done. To comb act these devastating injuries the specialist Reconstruction protocol is rewarding.

CONCLUSION

The basic success of this study is very much dependent on the team work done by orthopedic surgeon and plastic surgeons.

By a single stage aggressive radical approach the patients who are bread winners of family are benefited and returned to normal activities in a faster period.

The long hospital stay, expenditures to combat complications are avoided.

By co-ordinated team work, continuity of care and a policy of early reconstruction and rehabilitation the severe open tibial fracture can be managed successfully.

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CASE PROFORMA:

Patient's name :

Age/Sex :

Occupation / Income :

Address :

Associated Medical

Illness :

Mode of injury :

Time & Date of Injury :

Time & Date of Arrival

At Hospital :

Time of Surgery :

Type of injury :

Classification :

Other complications :

Initial Management given :

Pre-operative blood

Transfusion :

Antibiotics :

Size of implant :

Type of anesthesia :

Type of implant :

Specific difficulty during

Surgery :

Blood loss during surgery :

Duration of surgery :

C-Arm / X - Ray used :

Post – Operative period

DT removed on :

Suture removal done on :

Mobilization done on :

Post –Operative complications

Respiratory complications :

Local infection :

Nerve injury :

Vascular injury :

Embolism :

Limb length equality achieved :

Partial weight bearing started on :

Full weight bearing started on :

Any delayed complications

Non union

Screw breakage / loosening :

Plate breakage / loosening :

Infection :

Follow – up

Every 4 weeks

X-Ray

Range of movements in

Knee and Ankle :

KEY TO MASTER CHART

RTA – ROAD TRAFFIC ACCIDENT

ILN – Interlocking Nail

NDCP – Narrow Dynamic compression Plats

DI – Deep infection

SI – SUPERFICIAL INFECTION

RI - Relaxing Incisions

SSG – Split Skin Graft

MG – Medial Gastrocnemius

RS – Reverse Sural flap

CL – Cross Leg

PC – Primary Closure

S.No	Name	Age/ Sex	Mode of injury	Type of Classification facture Anderson	Timing of surgery in hours	Type of internal fixation	Soft tissue coverage	Blood Trans-fuation	Pos Cor
1	Arunachalam	28 yrs male	RTA	Grade - 3 b R Leg	6 hours	ILN	flap cover MG	1 unit	un
2	Ramachandiran	32 yrs male	RTA	Grade - 3 b R Leg	9 hours	ILN	flap cover MG	1 unit	une
3	Rajagopal	45 yrs male	RTA	Grade - 2 R Leg	7 hours	ILN	RI & SSG	1 unit	une
4	Ramadoss	48 yrs male	RTA	Grade - 3 b L Leg	14 hours	ILN	flap cover MG	1 unit	SI
5	Vijaya kumar	30 yrs male	RTA	Grade - 3 a L Leg	10 hours	ILN	flap cover MG	1 unit	SI
6	Malliga	28 yrs female	RTA	Grade - 2 R Leg	8 hours	ILN	RI & SSG	1 unit	une
7	Govindammal	45 yrs female	RTA	Grade -3 a R Leg	6 hours	NDCP	CL flap	1 unit	DI
8	Amulmary	45 yrs female	RTA	Grade - 3 a L Leg	16 hours	ILN	flap cover MG	1 unit	SI
9	Chandirasekar	35 yrs male	RTA	Grade - 2 R Leg	8 hours	ILN	PC	1 unit	une
10	Selva kumar	27 yrs male	RTA	Grade -3 b R Leg	4 hours	ILN	flap cover MG	1 unit	une
11	Meenaskshi	45 yrs female	RTA	Grade - 3 a R Leg	9 hours	ILN	RI & SSG	1 unit	SI

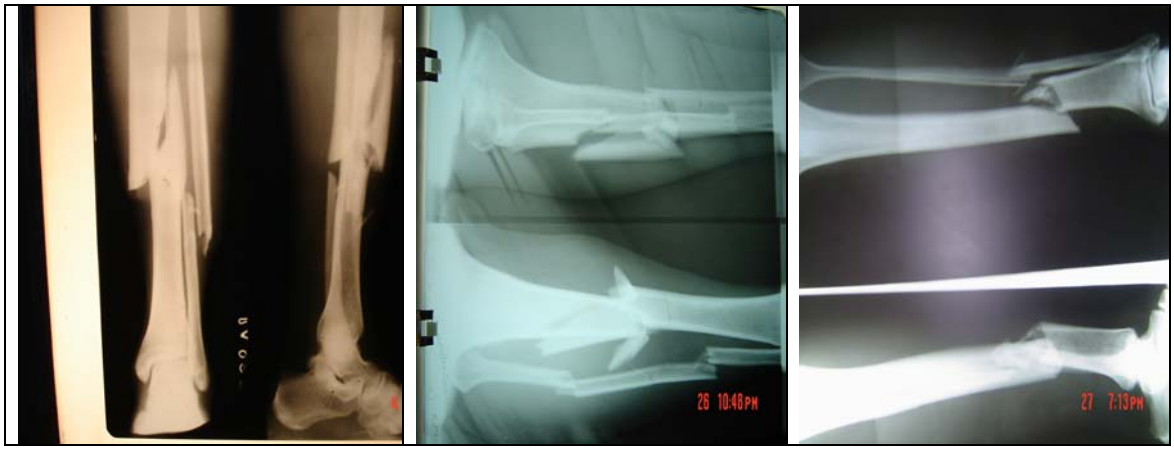
12	Sasi kumar	28 yrs male	RTA	Grade - 3 a L Leg	18 hours	ILN	RS	1 unit	DI
13	Augusten	38 yrs male	RTA	Grade - 3 a L Leg	11 hours	ILN	RI & SSG	1 unit	SI
14	Mohan	42 yrs male	RTA	Grade - 3 b L Leg	10 hours	NDCP	RS	1 unit	DI & nec
15	Gunasekaran	38 yrs male	FALL	Grade - 2 R Leg	8 hours	ILN	PC	1unit	une
16	Thirupathi	35 yrs male	FALL	Grade -2 L Leg	6 hours	ILM	PC	1 unit	une
17	Siva kumar	27 yrs male	RTA	Grade - 3 b L Leg	7hours	ILN	flap cover MG	1 unit	une
18	Sagulamir	23 yrs male	RTA	Grade - 3 a R Leg	12 hours	ILN	flap cover MG	1 unit	une
19	John Kennady	40 yrs male	RTA	Grade -3 a R Leg	16 hours	ILN	RI & SSG RS	1 unit	DI &
20	Arul Basker	37yrs male	RTA	Grade - 2 R Leg	24 hours	ILN	PC	1 unit	DI
21	Devadoss	35 yrs male	RTA	Grade -2 L Leg	8 hours	ILN	PC	1 unit	une

OPEN FRACTURES OF BOTH BONES LEGS

IN TRAUMA WARD

Saline wash given
Sterile dressing applied.
Immobilised in Thomas splint.

X-RAYS- PREOPERATIVE



X - RAY POST OPERATIVE

-

FLAP COVERAGE

		Medial Gastro-nemius Cross leg flap.

COMPLICATION

		Anterior knee Pain Deep infection necrosis

FOLLOW – UP

X – RAYS WITH GOOD UNION

RANGE OF MOVEMENTS